

4. PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL

4.1 PRODUCTION

Table 4-1 lists the facilities in each state that manufacture or process hexachlorocyclohexane, the intended use, and the range of maximum amounts of hexachlorocyclohexane that are stored on site. The data listed in Table 4-1 are derived from the Toxics Release Inventory (TRI94 1996). Only certain types of facilities were required to report. Therefore, this is not an exhaustive list.

HCH does not occur as a natural substance. The manufacture of technical-grade HCH involves the photochlorination of benzene, which yields an isomeric mixture consisting of α -HCH, β -HCH, γ -HCH, δ -HCH, ϵ -HCH, and inert *S*-isomers (IARC 1979); this reaction can be started by free-radical initiators such as visual or ultraviolet light, X-rays, or γ -rays (Kirk-Othmer 1985). Treatment with methanol or acetic acid, followed by fractional crystallization, concentrates γ -HCH to the 99.9% required in the technical-grade of γ -HCH (IARC 1979); nitric acid is used to remove odor (SRI 1987). None of the isomers or technical-grade HCH are currently produced in the United States. The production of γ -HCH exceeded 2.27×10^6 g in 1976 (HSDB 1997); commercial γ -HCH production in the United States reportedly ended in that year (EPA 1989b). However, the *Directory of Chemical Producers for 1987 and 1988* lists one producer of γ -HCH, Drexel Chemical Company (SRI 1987, 1988); subsequent volumes (1989–1991) give no listings of γ -HCH producers.

γ -HCH is available in emulsifiable and flowable concentrates, soluble concentrates/liquids, wettable powders, dusts, ready-to-use liquids, pressurized liquids and impregnated materials, oil base and aerosol sprays, granules, and as a smoke generator (Berg 1988; EPA 1985a). γ -HCH is sold separately or in combination with fungicides, fertilizers, other insecticides, or wood preservatives (Hayes 1982).

4.2 IMPORT/EXPORT

γ -HCH is imported to the United States from France, Germany, Spain, Japan, and China (EPA 1985a). The U.S. imports of γ -HCH declined from 1.52×10^8 g in 1977 to 8.53×10^7 g in 1982 (HSDB 1997). No import or export data are available for the other isomers of HCH. Facilities that import HCH for use as a formulation component are shown in Table 4-1. Since HCH is no longer produced in the United States, there is no export of the substance.

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Table 4-1. Facilities that Manufacture or Process Hexachlorocyclohexane

State	Location ^a	Range of Maximum Amounts on Site in Pounds ^b	Activities and Uses ^c
Drexel Chemical Co.	Cordele , GA	100,000–999,999	Import , On-site Use/ processing, Formulation Component
Gustafson Inc.	Marsing , ID	100,000–999,999	Formulation Component
Rigo Co.	Buckner , KY	10,000–99,999	Formulation Component
Platte Chemical Co.	Fremont , NE	100,000–999,999	Formulation Component

Source: TRI96 1998

^aPost Office state abbreviations used

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4.3 USE

γ -HCH is used as an insecticide, a therapeutic scabicide, pediculicide, and ectoparasiticide for humans and animals (Budavari et al. 1989). As an insecticide, it is used on fruit and vegetable crops (including greenhouse vegetables and tobacco), for seed treatment, in forestry (including Christmas tree treatment), and for animal treatment. γ -HCH has also been used in vaporizers, but this use was restricted as early as 1951 (Hayes 1982) and banned by the EPA in 1977 (IARC 1979). γ -HCH is registered for use on fruit and vegetable crops, ornamentals, tobacco, greenhouse vegetables and ornamentals, forestry, domestic outdoor and indoor uses by homeowners (including dog dips, house sprays, and shelf paper), commercial food or feed storage areas and containers, farm animal premises, wood or wooden structure sites, and military use on human skin and clothing (EPA 1985b).

Medically, γ -HCH is used topically for the treatment of head and body lice and scabies; it is available in 1% preparations as a lotion, cream, or shampoo (Huff 1988). The γ -HCH used in human and veterinary medicinal and pharmaceutical products must be 99% pure (Budavari et al. 1989). However, the use of γ -HCH for the treatment of scabies can be replaced with Permethrin, a pyrethroid insecticide with lower mammalian toxicity (Franz et al. 1996).

In February 1977, EPA issued a notice of rebuttable presumption against registration and continued registration (RPAR) of pesticide products containing γ -HCH. EPA took this action in response to indications of γ -HCH's potential carcinogenic effect, possible developmental and reproductive effects, possible blood dyscrasias, and delayed toxic effects, as well as its acute toxic effects seen in aquatic wildlife (IARC 1979). In October of 1983, EPA issued a "Notice of Intent to Cancel Pesticide Products Containing γ -HCH." The contentions concerning developmental and reproductive effects were successfully challenged by industry. EPA no longer permits the use of γ -HCH for purposes involving direct aerial application (EPA 1985b). The notice restricted certain applications of γ -HCH on livestock, structures, and domestic pets to certified applicators or persons under their direct supervision (EPA 1985b). In November 1993, EPA issued a "Notice of Receipt of a Request for Amendments to Delete Uses" for several formulations of lindane powder, 99.5% technical-grade HCH, and dust concentrate, which would delete from the pesticide label most uses of lindane for agricultural crops and use on animals and humans (EPA 1993). Currently, registration for most formulations of lindane have been canceled, with some remaining products registered for restricted use on commercial

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ornamentals, avocados, pecans, livestock sprays, forestry, Christmas trees, structural treatments, dog shampoos, and dog dusts (EPA 1998b).

4.4 DISPOSAL

Hexachlorocyclohexane is listed as a toxic substance under Section 313 of the Emergency Planning and Community Right to Know Act (EPCRA) under Title III of the Superfund Amendments and Reauthorization Act (SARA) (EPA 1995). Disposal of wastes containing hexachlorocyclohexane is controlled by a number of federal regulations (see Chapter 7).

While current disposal techniques may be adequate, new methods provide increased efficiency and quality of disposal at a greatly reduced cost. The use of demulsification, sorption, and filtration in combination with chemical and biological degradation of pesticide waste waters is being examined. This process is divided into two phases. First, demulsification agents (lignocellulosic materials, peat moss, wood products, etc.) are utilized in the removal of solubilized pesticides. In Phase II, the solid matter (pesticide-saturated sorbents and suspended particulates) are physically separated from the aqueous material through a variety of filtration techniques. The aqueous phase is either recycled or discarded, and the solid phase, in which the concentration of the pesticide is most significant, is further treated through composting (Mullins et al. 1992).

In order to facilitate the composting process, it is important to use sorption agents that provide a beneficial environment for the pesticide-degrading microorganisms. Peat moss, ground pine bark mulch, and steam-exploded wood fibers are excellent demulsifiers because they are highly sorbent, readily available, and inexpensive. They also provide the nutrients required by the degrading microorganisms, although the peat moss media require some carbohydrate enrichment. The solid waste can be either directly metabolized or co-metabolized by multiple species of microbes. The number of compost cycles, and therefore the amount of energy input required, depends on the pesticide concentration and on how easily the pesticide can be biodegraded. In preliminary studies by Mullin et al., this process has reduced the concentration of γ -HCH in waste materials significantly, with less than 1% of the original pesticide remaining after 24-hour incubation (Mullins et al. 1992).

Additional work is required, but the benefits of this disposal technique are clear. It is cost effective, reliable, and it can be adapted to the variety of disposal challenges presented by the multitude of pesticides that are

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currently used. The use of microbial consortia ensure that each pesticide will be degraded rapidly. This method can also be used on pesticide mixtures (Mullins et al. 1992).

Disposal methods are currently subject to significant revision by EPA (HSDB 1997).

